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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF: Thomas DROEGE, et al.
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FILED: HEREWITH
INTERNATIONAL APPLICATION NO.: PCT/EP03/02844
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FOR: COMPOSITE ELEMENTS

**REQUEST FOR PRIORITY UNDER 35 U.S.C. 119
AND THE INTERNATIONAL CONVENTION**

Commissioner for Patents
Alexandria, Virginia 22313

Sir:

In the matter of the above-identified application for patent, notice is hereby given that the applicant claims as priority:

COUNTRY	APPLICATION NO	DAY/MONTH/YEAR
Germany	102 13 753.6	26 March 2002

Certified copies of the corresponding Convention application(s) were submitted to the International Bureau in PCT Application No. PCT/EP03/02844. Receipt of the certified copy(s) by the International Bureau in a timely manner under PCT Rule 17.1(a) has been acknowledged as evidenced by the attached PCT/IB/304.

Respectfully submitted,
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Bescheinigung | Certificate | Attestation

Die angehefteten Unterlagen stimmen mit der ursprünglich eingereichten Fassung der auf dem nächsten Blatt bezeichneten europäischen Patentanmeldung überein.

The attached documents are exact copies of the European patent application described on the following page, as originally filed.

Les documents fixés à cette attestation sont conformes à la version initialement déposée de la demande de brevet européen spécifiée à la page suivante.

Patentanmeldung Nr. | Patent application No. | Demande de brevet n°

02080274.0

PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
p.o.

R C van Dijk

Anmeldung Nr:
Application no.: 02080274.0
Demande no:

Anmeldetag:
Date of filing: 13.12.02
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Anmelder/Applicant(s)/Demandeur(s):

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Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:
(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
If no title is shown please refer to the description.
Si aucun titre n'est indiqué se referer à la description.)

A method of irradiating a layer

In Anspruch genommene Prioriät(en) / Priority(ies) claimed /Priorité(s) revendiquée(s)
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AT BE BG CH CY CZ DE DK EE ES FI FR GB GR IE IT LI LU MC NL PT SE SI SK

A method of irradiating a layer

The invention relates to a method of irradiating a layer including: directing and focussing a radiation beam to a spot on said layer by means of at least one optical element; causing relative movement of the layer relative to said at least one optical element so that, successively, different portions of the layer are irradiated and an interspace between a surface of said at least one optical element nearest to said layer is maintained; and maintaining at least a portion of said interspace through which said radiation irradiates said spot on said layer filled with a liquid, the liquid being supplied via a first supply conduit.

In several embodiments of liquid immersion in dynamic systems, liquid immersion is maintained through continuously supplying liquid. An example is illustrated in Figure 1. A liquid film is maintained between the lens and the object by constantly supplying liquid through a first supply conduit, e.g. a hole, just upstream of the immersion lens at a sufficiently high pressure to avoid gas inclusion. The moving surface pulls the liquid to the image field, herewith ensuring the imaging field to be immersed. Even though with a careful design of the immersion system liquid flow can be kept low, still continuously liquid is supplied. For stable continuous operation, it is advisable to remove the liquid. In WO-A-02/13194 (PHNL000435) a specific embodiment of a system is proposed to remove the liquid, related to liquid immersion mastering of optical discs. However , this removal system has several disadvantages. In this invention disclosure an improved system is proposed suitable for the liquid removal in dynamic liquid immersion imaging in general.

The key problem in liquid removal of thin liquid films on moving substrates is to break up the adhesive forces. When the substrate moves fast (over about 0.5 m/s) this break-up requires large forces. The surface of the substrates, however, usually is very delicate, often a soft resist layer. The removal system should be carefully designed in order not to damage the surface. Imaging systems such as wafer steppers and optical disc mastering equipment usually are very sensitive to mechanical disturbances. Two phase flow of liquid

and gas, which is difficult to avoid in dynamic liquid immersion systems usually is accompanied by mechanical disturbances. These disturbances should be minimized in the liquid removal system.

The mechanism proposed to remove the thin liquid film without damaging the surface and minimizing mechanical disturbances is illustrated in Figure 2. Gas is pumped through a second supply conduit, e.g. a slit, at a pressure sufficiently high to have a net gas flow in the direction opposite to the direction of movement of the substrate (viewed from the liquid removal system). This gas flow pushes the liquid from the disc. The liquid than is removed through a drainage conduit, e.g. a vacuum channel located just upstream. The gas flow and thus herewith disturbances can be reduced by reducing the height of the slit. A flying height of smaller than 2 μm will be unpractical. More than 100 μm will result in very high gas flows. Typical values will be around 10 μm. The capacity of the vacuum channel should be larger than the water and net upstream gas flow to avoid chaotic splashing. The height of the vacuum channel should not be too large and the width of the vacuum channel should not be too large to have efficient suction of the liquid into this channel. The appropriate choices highly depend on the exact system. In the direction perpendicular of the movement of the substrate and in the plane of the substrate, the slit and vacuum channel should be at least the size of the liquid film. Putting the gas supply hole close to the vacuum channel can reduce the required gas pressure. Additional advantage of this system is that most non-sticking particles will be removed too.

To encompass this mechanism in a dynamic liquid imaging system, the liquid removal mechanism presented above should be:

- kept at a constant and short height above the substrate;
- downstream compared to the objective lens.

The constant and low flying height may be achieved by mounting the proposed mechanism to an air bearing. Provided that the substrate is sufficiently flat, a constant and low height can be maintained, without damaging the surface. The proposed mechanism even can be integrated within the air bearing, utilizing the high-pressure channel of the air bearing to push of the liquid from the surface.

In general, the substrate may move in any direction compared to the objective lens. To put the liquid removal system upstream for all directions of movement it can be put around the objective lens as illustrated in Figure 3. Then, the system can be mounted rigidly to the lens, herewith automatically ensuring that the flying height is kept constant. To avoid mechanical vibrations in the liquid removal system to be transferred to the objective lens, it

may be advisable to only have a weak connection. Then again an option is to maintain the flying height though an air bearing.

CLAIM:

1. A method of irradiating a layer including:

directing and focussing a radiation beam to a spot on said layer by means of at least one optical element;

causing relative movement of the layer relative to said at least one optical element so that, successively, different portions of the layer are irradiated and an interspace between a surface of said at least one optical element nearest to said layer is maintained; and

maintaining at least a portion of said interspace through which said radiation irradiates said spot on said layer filled with a liquid, the liquid being supplied via a first supply conduit;

characterized in that gas is pumped through a second supply conduit at a pressure sufficiently high to cause a net gas flow in the direction opposite to the direction of relative movement of the layer in order to remove the liquid from the layer through a drainage conduit.

ABSTRACT:

Liquid immersion in dynamic systems, such as wafer steppers in optical lithography and mastering machines in optical disc manufacturing may be accompanied by a continuous supply of liquid. For stable operation the liquid also has to be removed. In this invention, a mechanism and several embodiments are presented to remove the liquid.

Fig. 2

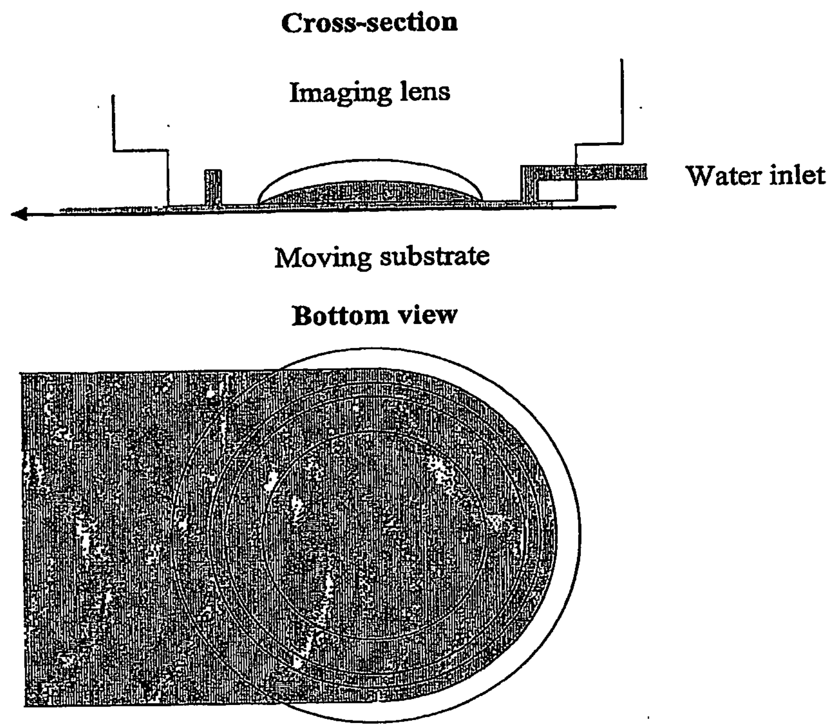


Figure 1: Liquid immersion in dynamic systems

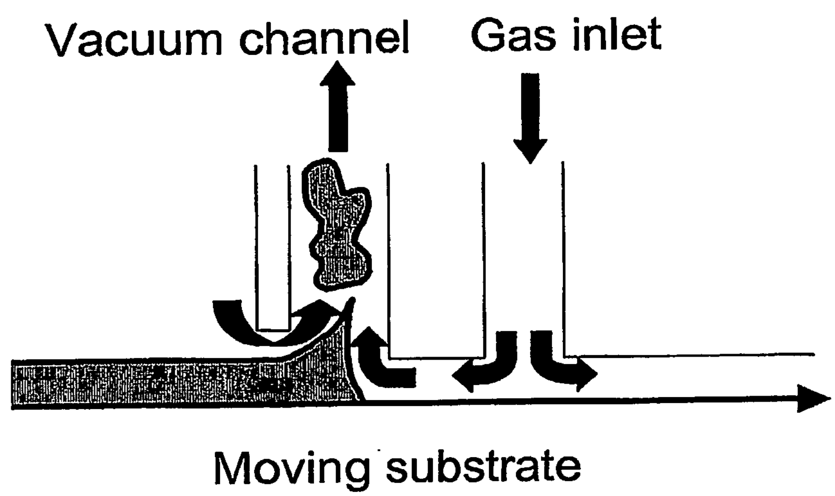
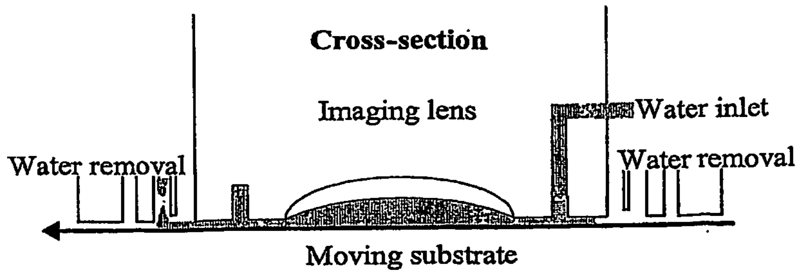


Figure 2: Mechanism for liquid removal.



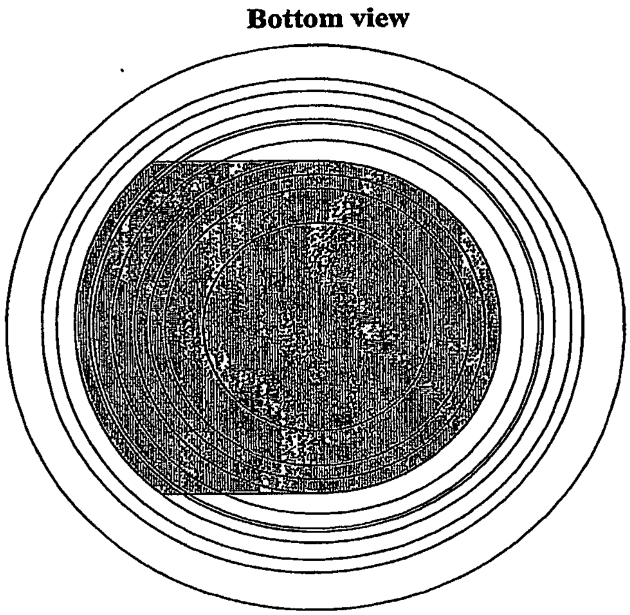


Figure 3: Implementation around objective lens.